

What is claimed is:

- 1 1. A method of forming a multi-layer semiconductor structure, the method  
2 comprising:  
3 disposing a first laminate over a first surface of a first semiconductor structure;  
4 disposing a second laminate over a first surface of a handle member;  
5 attaching the first laminate to the second laminate to provide a first  
6 semiconductor-handle complex having a substrate portion;  
7 removing at least a fraction of the substrate portion of the first handle-  
8 semiconductor complex to provide a handle-semiconductor complex having first and  
9 second opposing surfaces;  
10 positioning a first one of the first and second opposing surfaces of the handle-  
11 semiconductor complex over and in a contact relationship with a first surface of a second  
12 semiconductor structure; and  
13 attaching a first one of the first and second opposing surfaces of the handle-  
14 semiconductor complex to a first surface of a second semiconductor structure.
- 1 2. The method of claim 1 further comprising releasing at least a portion of one of the  
2 first and second laminates without releasing the first one of the first and second opposing  
3 surfaces of the handle-semiconductor complex from the first surface of the second  
4 semiconductor structure.
- 1 3. The method of claim 1 wherein attaching a first one of the first and second  
2 opposing surfaces of the handle-semiconductor complex to the first surface of the second  
3 semiconductor structure comprises bonding a second one of the first and second opposing  
4 surfaces of the handle-semiconductor complex to the first surface of the second  
5 semiconductor structure using a predetermined bonding material.
- 1 4. The method of claim 3, wherein disposing the first laminate over the first surface  
2 of the first semiconductor structure includes disposing a first laminate layer over the first  
3 surface of the first semiconductor structure wherein the first laminate layer is provided

4 having a reaction rate to a predetermined release agent which is greater than a reaction  
5 rate of the predetermined bonding material to the predetermined release agent.

1 5. The method of claim 4, wherein disposing the first laminate further includes  
2 disposing a second laminate layer over the first laminate layer.

1 6. The method of claim 5, wherein disposing the first laminate further includes  
2 disposing a third laminate layer over the second laminate layer.

1 7. The method of claim 4, wherein disposing the first layer of the first laminate  
2 includes disposing at least one of a first layer of zirconium; and a first layer of aluminum.

1 8. The method of claim 5, wherein disposing the second layer of the first laminate  
2 includes at least one of:

3 disposing a layer comprising copper over the layer of zirconium;  
4 disposing a layer comprising gold over the layer of zirconium;  
5 disposing a layer comprising tungsten over the layer of zirconium; and  
6 disposing a layer comprising a metal alloy over the layer of zirconium.

1 9. The method of claim 6, wherein disposing the third laminate layer of the first  
2 laminate includes at least one of:

3 disposing a layer comprising an inorganic dielectric over the second laminate  
4 layer;  
5 disposing a layer comprising copper over the second laminate layer; and  
6 disposing a layer comprising a polymer over the second laminate layer.

1 10. The method of claim 3, wherein disposing the second laminate over the first  
2 surface of the handle member further includes disposing a first laminate layer over the  
3 first surface of the handle member.

1 11. The method of claim 10, wherein disposing the second laminate further includes  
2 disposing a second laminate layer over the first laminate layer.

1 12. The method of claim 11, wherein disposing the second laminate further includes  
2 disposing a third laminate layer over the second laminate layer.

1 13. The method of claim 12, wherein:  
2 a first one of the first and second layers of the first laminate corresponds to a  
3 release layer; and  
4 a first one of the first and second layers of the second laminate corresponds to a  
5 release layer.

1 14. The method of claim 1, wherein attaching the first laminate to the second laminate  
2 comprises at least one of:  
3 attaching the first laminate to the second laminate using a temperature activated  
4 method;  
5 attaching the first laminate to the second laminate using a mechanically activated  
6 method; and  
7 attaching the first laminate to the second laminate using an electrically activated  
8 method.

1 15. The method of claim 2, wherein releasing at least one of the first and second  
2 laminates comprises disposing the multi-layer semiconductor structure into a solution  
3 chemically reactive with the at least one layer of at least one of the first and second  
4 laminates.

1 16. The method of claim 1, wherein releasing at least one of the first and second  
2 laminates comprises destroying the structural integrity of at least one layer of at least one  
3 of the first and second laminates.

1 17. The method of claim 1, wherein disposing the first laminate over the first surface

2 of the first semiconductor structure includes disposing the first laminate over a first  
3 surface of at least a portion of a first semiconductor wafer.

1 18. The method of claim 1, wherein disposing the first laminate over the first surface  
2 of the first semiconductor structure includes disposing the first laminate over a first  
3 surface of at least a portion of a first semiconductor die element.

1 19. A laminate adapted for releasably coupling a handle member to a semiconductor  
2 structure, the laminate comprising:

3 a first layer adapted to attach to a first surface of the semiconductor structure;

4 a second layer disposed over the first layer; and

5 a third layer disposed over the second layer, wherein at least one of the first,  
6 second and third layers includes a material having a predetermined reaction rate to a  
7 selected release agent.

1 20. The laminate of claim 19, wherein the first layer corresponds to a fusing layer.

1 21. The laminate of claim 20, wherein a first one of the second and third layers  
2 corresponds to a release layer.

1 22. The laminate of claim 21, wherein the third layer corresponds to the release layer.

1 23. The laminate of claim 22 wherein the third layer is adapted to attach to a first  
2 surface of a handle member.

1 24. The laminate of claim 22, wherein the third layer comprises a first one of  
2 zirconium and aluminum.

1 25. The laminate of claim 24, wherein the first layer comprises copper.

1 26. The laminate of claim 25 wherein the second layer comprises tantalum (Ta).

- 1 27. The laminate of claim 19 wherein:  
2 the third layer comprises tantalum (Ta);  
3 the second layer comprises one of Zirconium (Zr) and aluminum (Al); and  
4 the first layer comprises copper (Cu).
- 1 28. A method of providing a multi-layer semiconductor structure, the method  
2 comprising:  
3 providing a first semiconductor structure having first and second opposing  
4 surfaces; and  
5 disposing a laminate layer over a first one of the first and second opposing  
6 surfaces of the first semiconductor structure to provide a first semiconductor structure  
7 having a laminate layer disposed thereon.
- 1 29. The method of claim 28 further comprising:  
2 disposing a handle member over the laminate layer.
- 1 30. The method of claim 29 further comprising:  
2 a substrate on a second one of the first and second opposing surfaces of the first  
3 semiconductor structure.
- 1 31. The method of claim 30 further comprising:  
2 removing at least a portion of the substrate from the second one of the first and  
3 second opposing surfaces of the first semiconductor structure to provide a  
4 semiconductor-handle complex.
- 1 32. The method of claim 31 further comprising:  
2 providing a second semiconductor structure); and  
3 aligning a first surface of the semiconductor-handle complex with a first surface  
4 of the second semiconductor structure.

1 33. The method of claim 32 further comprising:  
2 bonding the first surface of the second semiconductor structure to the first surface  
3 of the semiconductor -handle complex.

1 34. The method of claim 33 further comprising:  
2 removing the handle member and the laminate layer.

1 35. The method of claim 28 wherein providing a first semiconductor structure having  
2 first and second opposing surfaces comprises:  
3 a substrate having first and second opposing surfaces; and  
4 a first semiconductor structure over a first one of the first and second surfaces of  
5 the substrate.

1 36. The method of claim 28 wherein providing a first semiconductor structure having  
2 first and second opposing surfaces comprises:  
3 providing a semiconductor structure comprised of a plurality of thin film  
4 semiconductor layers.

1 37. The method of claim 29 wherein disposing a handle member over the laminate  
2 layer comprises:  
3 providing a handle substrate;  
4 disposing a film layer over at least one surface of the handle substrate.

1 38. The method of claim 37 wherein the film layer is provided from one of: silicon  
2 nitride; and silicon dioxide.

1 39. The method of claim 38 further comprising disposing a laminate over a surface of  
2 the handle member.

1 40. The method of claim 29 wherein disposing a handle member over the laminate  
2 layer comprises disposing a handle member over the laminate layer such that a surface of

3 the laminate adheres to a surface of the handle member.

1 41. The method of claim 29 wherein disposing the laminate layer over a first one of  
2 the first and second opposing surfaces of the first semiconductor structure to provide a  
3 semiconductor structure having a laminate layer disposed thereon comprises providing a  
4 laminate layer comprised of a plurality of layers.

1 42. The method of claim 41 wherein providing a laminate layer comprised of a  
2 plurality of layers comprises:

3 providing a first layer corresponding to a release layer;  
4 providing a second layer corresponding to a metal adhesion / diffusion barrier  
5 layer; and  
6 providing a third layer corresponding to a fusion layer.

1 43. The method of claim 42 wherein the release layer comprises at least one of  
2 zirconium and aluminum.

1 44. The method of claim 42 wherein the metal adhesion / diffusion barrier layer  
2 comprises tantalum.

1 45. The method of claim 42 wherein the fusion layer comprises at least one of copper;  
2 a polymer; and an inorganic dielectric.

1 46. The method of claim 41 wherein providing a laminate layer comprised of a  
2 plurality of layers comprises:

3 providing a first layer corresponding to a metal adhesion / diffusion barrier layer;  
4 providing a second layer corresponding to a release layer; and  
5 providing a third layer corresponding to a fusion layer.

1 47. The method of claim 46 wherein the release layer comprises at least one of  
2 zirconium and aluminum.

1 48. The method of claim 46 wherein the metal adhesion / diffusion barrier layer  
2 comprises tantalum.

1 49. The method of claim 46 wherein the fusion layer comprises at least one of copper;  
2 a polymer; and an inorganic dielectric.

1 50. The method of claim 41 wherein providing a laminate layer comprised of a  
2 plurality of layers comprises providing a laminate layer comprised of two layers with a  
3 first one of the layers corresponding to a release layer and second one of the layers  
4 corresponding to one of:

5 a polymer having an adhesive characteristic which allows the laminate layer to  
6 adhere to the surface of the thin film semiconductor structure;  
7 an inorganic material; and  
8 copper.

1 51. The method of claim 28 wherein disposing a laminate layer comprises providing a  
2 laminate layer comprised of a single layer having an adhesive characteristic which allows  
3 the laminate layer to adhere to the surface of the semiconductor structure and having a  
4 characteristic such that the layer releases from the surface of the semiconductor structure  
5 in response to being exposed to a release agent.

1 52. The method of claim 29, wherein disposing a laminate layer comprises providing  
2 a laminate layer comprised of a single layer having an adhesive characteristic which  
3 allows the laminate layer to adhere to a surface of the handle member and having a  
4 characteristic such that the layer releases from the surface of the semiconductor structure  
5 in response to being exposed to a release agent.

1 53. The method of claim 31, wherein removing the substrate from the second one of  
2 the first and second opposing surfaces of the semiconductor structure to provide a  
3 semiconductor-handle complex comprises removing a portion of the second surface of



4 the semiconductor-handle complex using at least one of: a mechanical grindback, an  
5 aqueous chemical etch; a vapor chemical etch; and a plasma etch.

1 54. The method of claim 33, wherein bonding the first surface of the second  
2 semiconductor structure to the first surface of the semiconductor-handle complex  
3 comprises providing bonding pads on at least one of the first surface of the second  
4 semiconductor structure; and the first surface of the semiconductor-handle complex.

1 55. The method of claim 54, wherein the bonding pads are provided from at least one  
2 of: copper; a polymer; and an inorganic dielectric.

1 56. The method of claim 34 wherein removing the handle member and the laminate  
2 layer comprises using at least one of:

- 3 an aqueous-activated method;
- 4 a vapor-activated method;
- 5 a light-activated method;
- 6 a temperature-activated method;
- 7 an ion bombardment-activated method;
- 8 an electrically-assisted method; and
- 9 a mechanical method.

1 57. The method of claim 28 wherein the semiconductor structure corresponds to a  
2 die-to-die semiconductor structure.

1 58. The method of claim 28 wherein the semiconductor structure corresponds to a  
2 die-to-wafer semiconductor structure.

1 59. The method of claim 28 wherein the semiconductor structure corresponds to a  
2 wafer -to-wafer semiconductor structure.

1 60. The method of claim 28 wherein:

2 providing a first semiconductor structure having first and second opposing  
3 surfaces comprises providing a first semiconductor structure having a face surface and a  
4 backside surface; and

5 disposing a laminate layer comprises disposing a laminate layer over the face of  
6 the first semiconductor structure to provide a semiconductor structure having a laminate  
7 layer disposed thereon.

1 61. The method of claim 32 wherein:

2 providing a second semiconductor structure comprises providing a second thin  
3 film semiconductor structure; and

4 aligning a first surface of the semiconductor-handle complex with a first surface  
5 of the second semiconductor structure comprises aligning the backside of the  
6 semiconductor-handle complex with a face of the second thin film semiconductor  
7 structure.

1 62. The method of claim 1 wherein:

2 the first semiconductor structure corresponds to an original semiconductor  
3 substrate;

4 the first semiconductor-handle complex having a substrate portion corresponds to  
5 an original-handle complex having a substrate portion;

6 the handle-semiconductor complex corresponds to a handle-thin film complex;

7 the second semiconductor structure corresponds to a second substrate.

1 63. The method of claim 62 wherein:

2 the original semiconductor substrate corresponds to a first thin-film substrate

3 the second substrate corresponds to a second thin-film substrate.

1 64. A method of providing a multi-layer semiconductor structure, the method  
2 comprising:

3 providing a handle member having first and second opposing surfaces; and

4 disposing a laminate over a first one of the first and second opposing surfaces of  
5 the handle member to provide a handle member having a laminate disposed thereon.

1 65. The method of claim 64 further comprising:  
2 providing a first semiconductor structure; and  
3 attaching the laminate to a surface of the first semiconductor structure to provide  
4 a first semiconductor structure having a handle member coupled thereto.